VIA UPS

Mr. David Keith
Project Coordinator
Anchor QEA, LLC
614 Magnolia Avenue
Ocean Springs, MS 39654

RE: Draft Chemical Fate and Transport Modeling Study Report
San Jacinto River Waste Pits Superfund Site, Harris County, Texas
Unilateral Administrative Order, CERCLA Docket No. 06-03-10

Dear Mr. Keith:

The Environmental Protection Agency (EPA) and other agencies have performed reviews of the above referenced document dated February 2012. The enclosed comments shall be incorporated in the Final Chemical Fate and Transport Modeling Study Report and copies provided for review and approval in accordance with the approved schedule.

If you have any questions, please contact me at (214) 665-8318, or send an e-mail message to miller.garyg@epa.gov.

Sincerely yours,

Gary Miller
Remediation Project Manager

Enclosure

cc: Luda Voskov (TCEQ)
Bob Allen (Harris County)
Nicole Hausler (Port of Houston)
Jessica White (NOAA)

miller:4/27/12:L:\Superfund\oversight\sjrwp draft ram cmts ltr 4-27-2012

SANCHEZ
6SF-RA

9340795

Comments
Draft Chemical Fate and Transport Modeling Study Report dated February 2012

1. (Section 1.1, Fig. 1-1): Delineate the study domain in this figure.
2. (Section 1.2): Figure 1-2 was not included in the modeling report.
3. (Section 1.3): The footnote that states 'those data gaps do not affect or limit this analysis'. This statement needs to be justified.
4. **(Section 3.4, Section 4.2.2, and Appendix G):** An effective bed roughness value of 1.0 cm was used for the current velocity calibration. However, in the sediment transport modeling, bed shear stress was calculated using an effective bed roughness value of 2 mm. The apparent use of a model effective bed roughness value that is different from the calibration effective bed roughness value violates the purpose of determining calibration values and introduces significant error into the simulation results for sediment transport processes (e.g., erosion, re-suspension, deposition, etc.). The modeling shall use parameters that are consistent with the calibration results unless there is a justification of the validity provided for the departure.

5. **(Section 2.1, p. 7):** Vessel effects and wind-generated waves were not included in model. These effects shall be included and described in the report.

6. (Section 2.2.2, p. 9): Justify not simulating organic solids in the model framework. In addition, clarification of footnote 3 is needed since marine traffic (other than the San Jacinto River Fleet) including dredges and barges have had operations in this area prior to 2011.

7. (Section 2.3, p. 11): Data should be presented to justify the use of a depth-averaged hydrodynamic model.

8. **(Section 3 and Appendix A):** The bathymetry and floodplain topography of the model domain were used to define the thickness (water depth) of each model cell. Various datasets were used to assign cell values. Where data were not available for individual cells, values were assigned by interpolation of existing cell data. Details of the interpolation method(s) are not provided in the report. The report shall include this information.

9. (Fig. 3-2): The shoreline legend box is confusing. What feature in this figure is the white shoreline supposed to represent?

10. (Section 3.1, p. 14): In footnote 7 it states that 'sediment transport and contaminant fate model predictions are not relevant to this portion of the HSC'. This statement should not be included in a footnote, and needs to be technically justified and supported with data. The explanation given in the report in support of this major assumption is not satisfactory.

11. **(Section 3.3.1, p. 15):** Inflow rates at the Lake Houston Dam include tainter gate discharge. However, the tainter gate position is adjustable and the methodology used to account for its rating curve with respect to its height variability is not provided. The report shall provide this information.

12. (Section 3.3.1, p. 18): What is the return period for the 356,000 cfs flow rate, and exactly where did this peak flow rate occur?

13. (Section 3.3.3, p. 20): Verified WSE data from Morgan's Point are available from 1996 to present. Thus, it seems that predicted WSE were used in the model from 1990-1996 and that data from 1996 to 2011 were used for the downstream boundary conditions. Please clarify this matter.

14. **(Section 3.3.3, p. 20):** This section selects 16 ppt as the salinity inputs from the bay boundary of this model. This selection seems somewhat arbitrary. Recent work (for example: Technical Support for the Analysis of Historical Flow Data from Selected Flow Gauges in the Trinity, San Jacinto, and Adjacent Coastal Basins at http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0900010996_GalvestonBaySalinity.pdf) presents the fact that salinity does vary in this system contrary to the statement in this section that states "Salinity has minimal variation in the system..." The report shall clarify whether water density variation within the range of salinity variation at this site affects potential transport of sediments and ultimately the pollutants at this site. In addition, the report shall report the effect of the longitudinal salinity gradient on the hydrodynamics of the modeled water body.

15. **(Section 3.3.3, p. 20):** The hydraulic regime at the confluence of the Houston Ship Channel at the San Jacinto River (Battleship Texas gauge station) is fundamentally different than that which occurs at the mouth of the San Jacinto River at Galveston Bay (Morgan's Point gauge station). While approximately symmetrical tidal currents can be expected at both the Battleship Texas and Morgan's Point gauge stations during non-event periods, the symmetry should not exist during periods of flooding. A decoupling of water surface elevations between stations is expected during flood events due to a local heightening of water surface elevation from increased freshwater flow at the mouth of the Houston Ship Channel compared to that of the more tidal-influenced, more open marine environ of Galveston Bay (e.g., Thomann, 1987). Consequently, the water surface elevation response at the downgradient model domain boundary (Battleship Texas) would be significantly different than the water surface elevation response downstream at Galveston Bay (Morgan's Point) during a flood or surge event. As such, the use of data from Morgan's Point may to be inappropriate for use in calibrating the subject model. For the purpose of satisfying the necessary verification of the hydrodynamic model calibration, the following procedure shall be used: 1) use the current model calibrated with non-flood event water surface elevation data, 2) find a period of time for which data exist at the Battleship Texas station and over which a significant flood event is observed, 3) run the EFDC model, as calibrated, 4) from the resulting model run: compare the simulated water surface elevations at Battleship Texas (which is contained within the model domain against the actual data collected at the same gauge station, and finally 5) from the resulting model run: compare the model-predicted water surface elevations at Battleship Texas against the observed water surface elevations at the Morgan's Point gauge station. The report shall include a description of this procedure and the results to determine whether event-driven decoupling of water surface elevations is observable and on what scale it may occur.

16. **(Section 3.4, p. 20; and Appendix B):** Acoustic Doppler Current Profiler (ADCP) data during May 10 – July 13, 2011 were used in calibration, but data during July 14 through November 15 (Appendix B) were not compared to the model results. The report shall include a comparison of the model results to the July through November data**13.**
(Section 3.4, p. 21): The comparison of the east-west component of the depth-averaged velocity shown in Fig. 3-14 shows significant differences between predictions and measurements. The north-south component shows significant differences during the peak flows on July 2–4, 2010. Statistical parameters (e.g., RMS error, Relative RMS error) should be included that quantifies the agreement between the measured and predicted stages and flows. Based only on the comparison of the plotted times series shown in this figure, we do not completely agree with the last sentence in this paragraph that states 'the calibration results demonstrate that the model is able to simulate the hydrodynamics within the Study Area with sufficient accuracy to meet the objectives of this study'.. At a minimum the report shall include a sensitivity analysis to assess these observed differences between the measured and simulated depth-averaged velocities and provide a discussion of the results.

17. **(Section 4.2.2, and Appendix C):** Class 1 cohesive bed sediment was classified as having a median particle size (D50) of 0.25 mm. Therefore, cohesive bed sediment is characterized by a grain-size population where 50% of the particle mass is medium sand or larger (e.g., Folk, 1972) and can be classified as "fine to medium sand." In a description of SEDZLJ, the program module is used to simulate sediment bed erosion and deposition (Sec 4.1). Sediment grain sizes larger than 0.2 mm are considered to be non-cohesive (James et al., 2005). Based on the discussion here, most of the sediment comprising the cohesive Class 1 category is composed of grains defined as non-cohesive. The simulation of sediment ascribed as cohesive whose dominant make-up is actually non-cohesive leads to results that adversely affect the goal of realistic sediment bed simulation. One specific result is the tendency for Class 1 sediment gross erosion to be under-estimated. Class 1 sediment is defined in Sec 5.2.8.2.1 of the report as being composed of particle size less than 62 µm. The D50 for median particle size shall be consistent with this Class 1 particle size definition.

18. **(Section 4.**2.2, p. 25): The reference Ziegler and Nisbet (1994) was cited as the source of the criteria for determining if sediment from a given grab sample could be classified as being cohesive – D_{50} < 250 µm and clay/silt content > 15%. These criteria is believed to be too general in that a sediment's degree of cohesiveness would depend more on the Cation exchange capacity of the dominant clay minerals in the sample as well as the ratio of clay to silt size sediment in the sample. As such, it is recommended that either a more site-specific determination be made or a more traditional definition of D50 being < 63 µm be used.

19. (Section 4.2.2, p. 26): A justification for assuming the sediment bed was hard bottom in the San Jacinto River channel downstream of Lake Houston Dam and in the HSC shall be added to the report. How far downstream in the river channel was a hard bottom assumed?

In addition, the report shall comment on potential impacts of these assumptions on sediment and contaminant transport processes in proximity to the Superfund site.

20. **(Section 4.**2.2, p. 26): It states in the second paragraph that 16 samples were used to determine the average dry density that was assigned to cohesive bed areas. Show where the 16 samples were collected.

21. **(Section 4.**2.2, p. 27): It states that the maximum bed shear stress in the study area was 87 Pa. This must be a typo. Please correct this value of the maximum shear stress. The next paragraph states that the average of 53 GSD samples obtained from non-cohesive areas was used for the D50 value for non-cohesive bed grid cells. Show where the 53 samples were collected.

22. **(Section 4.**2.2, p. 28): State the range of D_{90} values found in the GSD data. Is 1,000 µm the median value?

23. (Section 4.2.2, p. 28): Bed erosion parameters were assumed to be horizontally constant as the Sedflume data did not indicate any discernible spatial pattern. The effect of this assumption was addressed by a sensitivity analysis. However, the analysis varied the erosion parameters uniformly throughout the model; it did not change the erosion parameters within the area of interest for potential remediation. A sensitivity analysis that varies key parameters horizontally within the EPA preliminary perimeter shall be conducted and included in the report.

24. **(Section 4.**2.2, Table 4-2): The critical shear stress of 0.62 Pa for the top layer indicates that this 5 cm layer must be fairly consolidated. What is the average bulk density of the top layers in the 15 cores?

25. (Section 4.2.3, p. 30): Equation 4-5 is a log-log relationship.

26. **(Section 4.**2.3, p. 31): Explain the reasoning associated with the professional judgment that was used to estimate the trapping efficiency of Lake Houston. In the last sentence of the first paragraph it states "which was adjusted during model calibration". Was the composition of the incoming load adjusted, or was the assumed trapping efficiency adjusted during calibration? In addition, why were TSS data (which typically would include inorganic and organic solids) used to develop Eq. 4-5 and not concentrations of suspended inorganic sediments, especially considering that production and transport of organic matter was not simulated?

27. (section 4.2.3, p. 31): What sediment size class was set to 25 mg/L at the downstream tidal boundary and tributaries to the HSC? Since these were TSS data and not just concentrations of inorganic sediment, how was the 25 mg/L divided into organic and inorganic size classes in the model?

28. **(Section 4.**3, p. 31): The last sentence in the first paragraph states that model performance was also evaluated by comparing measured and predicted TSS concentrations at the two TCEQ stations shown in Fig. 4-18. Where is this comparison shown and discussed?

29. **(Section 4.3, p. 32):** The report indicates that the sediment transport model was, in part, calibrated using the settling speed of Class 1 sediment. The Class 1 settling speed used in the calibration is reported to be 1.3 m/d. However, the equation used for Class 1 (cohesive) settling is not evident in the information provided in the main text and Appendix G of subject report, or from James et al. (2005). The report does not include information regarding the specific model used in the determination of the Class 1 settling speed and/or the equivalent effective median grain size of the Class 1 fraction. The report shall include this information.

    Section 4.3, p. 33): How were the two qualitative conclusions made in the last two sentences of the first paragraph ("Overall, the model predicts net sedimentation with reasonable accuracy' and 'The general pattern of net sedimentation is qualitatively consistent with known characteristics of the Study Area') arrived at? Were there additional data that were not presented in this report utilized in reaching this conclusion? If so, references should be cited in the report. EPA comes to a different conclusion when examining the comparisons shown in Figs. 4-19 and 4-20, especially for two of the three stations within EPA's Preliminary Site Perimeter. The under-prediction factors at stations SJRI004, SJRI005, and SJRI006 are not reported. These shall be calculated and included in the report.

30. (Section 4.3, p. 33): a) In the second paragraph, some wording should be added to the sentence ("This comparison of predicted ….") that begins in the 11th line of this paragraph that while the overall distribution of NSR might have been reproduced by the model, there are areas where localized differences did occur. Statistical parameters should be included in the report that quantifies the level of agreement between the measured and predicted NSR.

    b) Was the sediment mass balance mentioned in the next to last sentence in this paragraph performed over the entire model domain?

    c) Given that 'a wider range of bed elevation change is predicted in the on-cohesive bed areas', what conclusion was reached specifically for the non-cohesive bed areas in the model domain or Study Area?

31. (Section 4.3, p. 34): The cumulative frequency plots of TSS shown in Figures 4-24 and 4-25 do not show the timing of the sampling and may fail to show a systematic error. Time series plots for the two sampling stations should be included to compare the model and TSS data.

32. (Section 4.4, p. 35): Describe how the rates of gross erosion, gross deposition, etc. that are graphed in Figure 4-26 were calculated. Also, explain how the increase in net deposition of 110% to 150% was calculated.

33. (Section 4.4, p. 35): Figures 4-26 and 4-27 show sediment transport sensitivity results for the entire Study area. Since remedial measures will focus on specific areas within the Superfund site, sensitivity analysis results for the portion of the Study area within the site should also be reported.

34. **(Section 4.5, p. 36):** A consequence of designating the boundary condition for in-coming sediment load to be a proportion of sediment load entering Lake Houston is that the in-coming sediment load must equal 0.0 mg/L during periods when there is no discharge at the Lake Houston Dam. This shall be confirmed, and a discussion of the potential consequence to model calibration shall be included.

30. (Section 4.5, p. 36): The first sentence ends with the statement that 'the model reproduces the overall distribution of NSR'. Considering what the objective of this modeling study is and how the models are going to be used during the FS, a quantitative measure of the model's agreement with 'the overall distribution of NSR' needs to be included in this report. In addition, a figure that shows the effect of spatial scale on model uncertainty, similar to what AnchorQEA has produced at other sites where they performed sediment transport modeling, e.g., the Lower Duwamish Waterway, WA, should be generated for this sediment transport model.

31. **(Table 4.1):** The cohesive Class 1 sediment erosion flux to suspended load (vs bed load) is not based on class size D50, rather, it is calibrated. The report does not provide information regarding the value(s) of effective diameter for Class 1 sediment resulting from the model calibration. The report shall include this information..

32. (Section 5.2.3, p. 41): In the legend box for Figure 5-4, the red triangle is labeled as "Upstream Inflow Boundary". However, the two red triangle locations are not at the model's upstream boundary. Correct the labeling in the legend box.

33. (Section 5.2.3, p.42): The sentence that begins "Therefore, the average .." mentions five inflow boundaries with the HSC. Are these five inflow boundaries labeled on some figure?

34. (Section 5.2.6.2, p. 51): Give a reference for the equation that relates Kdoc to Kow.

35. (Section 5.3.1, p. 62): Recommend that 'factor of 1.5 to 3' be changed to 'multiplicative factor of 0.33 to 0.67'.

36. (Section 5.3.2.1.1, p. 65): To show more conclusively that the model captures the lateral variation in the water column concentration reasonably well, as it states in the last sentence in the third bullet, the time series of predicted concentrations at the grid cells in which the TCEQ data and TMDL study data were collected should be plotted, and the measured concentrations should be plotted on these two plots.

37. (Section 5.3.2.1.2, p. 66): The temporal patterns in model predictions should be shown averaged over only the EPA's Preliminary Site Perimeter as well as averaged over only the

cells within the perimeter of the northern impoundments. Data measured within these two areas should also be shown on these time series plots.

38. (Section 5.3.2.1.3, p. 68, line 1): We recommend that “Laterally and longitudinally averaged” be added before “Model predictions of”. Also, as seen in Figures 5-20a-b, the model over predicts the TCDD and TCDF particulate concentrations and under predicts the dissolved concentrations. Comment on this as well as the implication of the underprediction of the dissolved concentrations on estimating the biota levels.

39. (Section 5.3.2.2, p. 69): The smaller decreases in the model averaged concentrations compared to the data-based SWACs seen in Figs. 5-21 most definitely need to be taken into consideration when the model is used during the FS. The statement “are considered to be within the range of uncertainty in the SWAC-based analysis” should be supported by providing the estimated uncertainty for this uncertainty. If the uncertainty was not calculated, on what basis was this statement made”. It also states that the “SWACs are strongly affected by a few high concentration samples”. It is recommended that the five identified outlier data points not be included and the SWAC values be recalculated. Both the original and recommended new SWAC analysis should be included in the report.

40. (Section 5.3.2.2, p. 70, 2nd para, line 6): ‘they are within a factor of 2’ should be ‘they are within a factor of 2.5’.

41. (Section 5.3.3, p. 71): Contaminant model sensitivity analysis was done separately for four parameters rather than jointly for combinations of parameters as was done for the sediment transport model. While the model results showed little variation to individual parameters, combinations of parameters may produce greater variations. This issue should be addressed in the report.

42. (Section 5.3.3.2.1, p. 73): Referring to Fig. 5-23a, comment on the comparison between the TMDL study data at the two stations upstream of river mile 10 and the range of model predictions from lower to higher upstream boundary conditions.

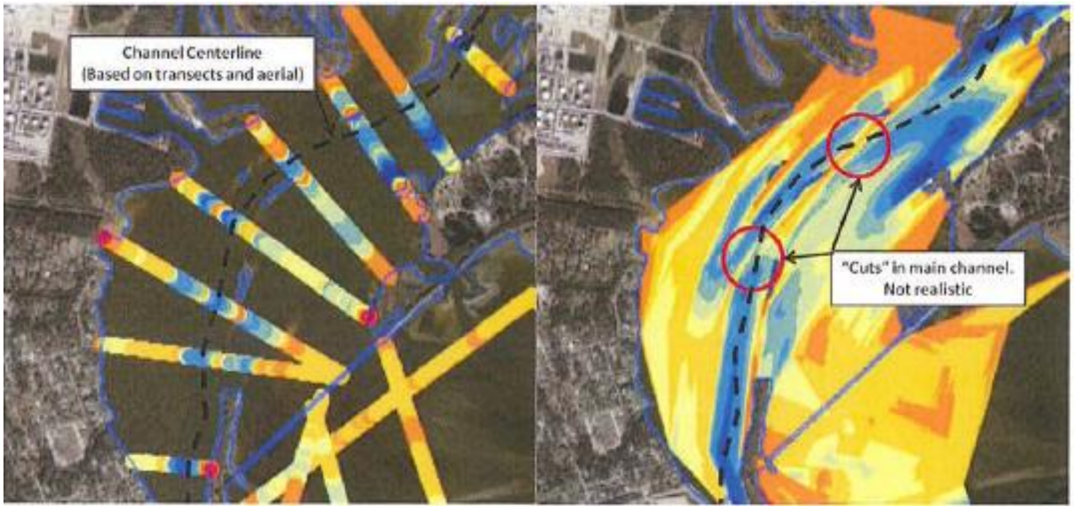
43. (Section 5.3.3.2.4, p. 75): EPA believes that the model is more than ‘somewhat sensitive’ to porewater DOC since model predictions vary by up to a factor of 4 for TCDF.

44. (Section 6.1, p. 81): The statement “the fate model predicted a decline in surface sediment concentrations within the area surrounding the Site …, consistent with data-based evaluations” should be modified to reflect the factor of 2.5 differences noted in a previous comment.

45. (Section 6.2, p. 81): What changes will have to be made to the sediment transport model’s parameterization in order to evaluate the impacts of the TCRA capping project?

46. **(Figures):** A map shall be included, which displays gross erosion rates in the model domain, including all cells for which Egross=0.0, based on Equation G-26.

47. **(Appendix A):** With regard to Figure A-3, upstream bathymetric interpolation cuts the main channel twice near Grennel Slough (see figure below). This may affect upstream flow conditions and as such should be investigated.



48. **(Appendix A, p. 2):** Bathymetric survey did not cover area within EPA's Preliminary Site Perimeter (see Figure A-1). This appears to be a significant gap in the bathymetry data needed for the model. Explain why data within this area was not obtained and describe the data used to set the depths of model cells in this area.
49. **(Appendix B, p. 2):** ADCP measurements were conducted May 10 through November 15, 2011. However, Figures B-1 through B-3 show data for May and June only. Plot the remaining velocity data and include the plots in the report.
50. **(Appendix B, p. 2):** ADCP data were not obtained at high flows because such flows did not occur in 2011. Would the study team conduct ADCP measurements during high flow events if such flows occur in the near future?

51. **(Appendix E):** A single value for the three erosion rate parameters was obtained for each of the five depth intervals from each core. A "log-average" (geometric mean) value was determined for the proportionality constant, *A* (Equation E-1), at each depth interval (Table E-6). As is normal, the geometric mean results in values of *A* for the Sedflume data sets (Table E-1 through Table E-5) are significantly lower than the arithmetic mean for the same data sets. Use of the lower values of A results in significantly lower values of the average gross erosion rates for each depth interval (Equation E-2). No rationale is provided to justify use of the geometric mean for the proportionality constant, and the report shall provide this rational.

52. **(Appendix E):** The results of the Sedflume experiments were used to develop average critical shear stress (τcr) values for each sediment layer (e.g., Table E-1 through Table E-5). However, the *average* critical shear stress (τcr) values (Table E-6) were determined using the arithmetic mean, not the geometric mean (as for the proportionality constant), which results in the significantly higher value of the two means. The use of the higher arithmetic average value, rather than the lower geometric average value for the critical shear stress (τcr) results in a lower gross erosion rate (Egross; e.g., Equation E-2). Together

with the geometric average of the proportionality constant, the use of the arithmetic average of critical shear stress reinforces a biased tendency towards lower erosion in the model domain. The report shall provide a rational for the use of the arithmetic mean.

53. (Appendix F, p. 5): Explain how the "effects of uncertainty due to selection of dat to use in the log-linear regression were also accounted for in the analysis".

54. **(Appendix F):** Of the ten (10) cores used in the $_{137}$Cs isotopic study, data from only one core (SJR1005) were usable (e.g., Table F-3). Evaluation of the data from Core SJR1005 indicates there were only two detections (Figure F-6). The two data points from Core SJR1005 were used to assign a date to the corresponding sediment depth from which a net sedimentation range was determined (e.g., Table F-3). However, the report does not provide which of the four (4) typical interpolation methods (e.g., USGS, 2004) were used. The report shall include this information. In addition, include the r^2 values for the regression lines of the slopes for the upper and lower bounds.

55. **(Appendix F and Appendix H):** The $_{137}$Cs and $_{210}$Pb activity analytical results were reported with significant experimental error (e.g., Figure F-2 through Figure F-11, Subject Report). Linear regression was performed to find the slope of the line defined by those 210Pb data that were judged to be unsupported (Append F, Subject Report) versus their core depth to determine net sedimentation rates (Figure F-12 through Figure F-26, Subject Report). However, the regressions do not incorporate the variance of experimental error associated with each datum. Therefore, a range of slopes and, consequently, net sedimentation rates, exists at each core location. Only "mean" net sedimentation rates are reported, but not the significant deviation inherent in the analyses. Use of $_{137}$Cs isotopic data from a sediment core for determining net sedimentation rates and/or age dating is predicated upon corroborating data obtained from other cores in the same depositional system (e.g., USGS, 2004). However, in this instance, there are no such corroborating data. Therefore, the single $_{137}$Cs net sedimentation rate (Item H.2) reliability or applicability to the model domain cannot be determined. An evaluation of the net sedimentation rates in the model domain was also performed using the $_{210}$Pb isotopic system. Contrary to the more suitable applicability of the $_{137}$Cs isotopic system to a depositional environment that is relatively dynamic (Item H.1), the $_{210}$Pb system "*… performs best in relatively quiet depositional areas …*" (Jeter, 2000). The $_{210}$Pb system age dating method is "*… more useful for age-dating cores from low-sedimentation-rate lakes with undisturbed watersheds where the input of contaminants is dominated by atmospheric fallout …*" and is less useful "*… in high-sedimentation-rate lakes with developed watersheds where the input of contaminants is dominated by fluvial loading from one or more streams …*" (USGS, 2004). As such, the $_{210}$Pb method would be expected to be even more adversely affected by the depositional environment than that for the $_{137}$Cs system and is significantly less suitable to the relatively high-energy depositional environment that comprises the subject study area. Model sensitivity runs shall be completed for a full range of net sedimentation rates, and the results discussed in the report, as well as the rational for selecting the ranges of net sedimentation rates.

56. **(Appendix F):** The map of NSR in Figure F-27 indicates that net sedimentation rates are higher north of the I-10 bridge than south of it. Do the results from the model simulations show a similar pattern?

Editorial Comments

(Section 3.2, p. 14, line 6): Possible typo: “13 transects downstream” instead of 12.

(Section 3.3.1, p. 17, line 15): Possible typo: 27% instead of 37%.

(Section 3.3.3, p. 20, line 19): Was unable to find full citation for Berger et al. (1995) in the references.

(Section 5.2.3, p. 42, line 1): Add to the end of the sentence that begins “This factor was taken into ..” something along the lines of “at this boundary, as will be explained in Section 5.X.X”.

(Section 5.2.6.2, p. 51, 2nd para, line 4): Change ‘were used to inform’ to ‘was used to inform’.

***Includes NOAA comments & TCEQ comments through #* 18**